

Claims

1. A nucleic acid molecule comprising (i) a nucleic acid sequence encoding a biofilament, (ii) a promoter that directs expression of a polypeptide in milk-producing cells or urine-producing cells, said promoter operably linked to said sequence, and (iii) a 5 leader sequence that enables secretion of said biofilament by said milk-producing cells or said urine-producing cells, into, milk or urine, respectively, of a mammal.

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B* 2. A mammalian embryo whose nucleus comprises the nucleic acid molecule of

claim 1.

10 3. A female mammal in which the genome of the mammary tissue of said female mammal comprises the nucleic acid molecule of claim 1, wherein said promoter is milk-producing cell-specific.

4. The mammal of claim 3, wherein said mammal is a selected from the group consisting of a rodent, a ruminant, and a goat.

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B 2* 15 5. An animal in which the genome of cells that contribute to urine production in said animal comprises the nucleic acid molecule of claim 1, wherein said promoter is urine-producing cell-specific.

6. The animal of claim 5, wherein said animal is a mammal.

7. The nucleic acid molecule of claim 1, wherein said biofilament is spider silk.

8. The nucleic acid molecule of claim 7, wherein said spider silk is dragline silk.

9. The nucleic acid molecule of claim 1, wherein said biofilament, when secreted such that the secretion is subjected to shear forces and mechanical extension, has a poly-alanine segment that undergoes a helix to a  $\beta$ -sheet transition, said transition forming a  $\beta$ -crystal that stabilizes the structure of said biofilament.

10. The nucleic acid molecule of claim 1, wherein said biofilament has an amorphous domain that forms a  $\beta$ -pleated sheet such that inter- $\beta$  sheet spacings are between 3 angstroms and 8 angstroms in size.

11. The nucleic acid molecule of claim 1, wherein said biofilament has a C-terminal amino acid motif comprising an amorphous domain and a crystal forming domain, said motif having a sequence that is at least 50% identical to SEQ ID NO: 2.

12. The nucleic acid molecule of claim 1, wherein said biofilament has a consensus sequence that is at least 50% identical to SEQ ID NO: 3.

13. A method for producing a biofilament, said method comprising the steps of:

(a) providing an embryonal cell transfected with a biofilament encoding nucleic acid molecule that expresses and causes secretion of said biofilament from a cell derived from said transfected embryonal cell;

(b) growing said embryonal cell to produce an animal comprising biofilament expressing and secreting cells; and

20 (c) isolating said biofilament from said biofilament expressing and secreting cells

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~~from said animal.~~

14. A method for producing a biofilament, said method comprising the steps of:

(a) providing an animal cell transfected with a nucleic acid molecule that contains  
(i) a nucleic acid sequence encoding a biofilament, (ii) a promoter that directs expression  
of a polypeptide in an animal cell, and (iii) a leader sequence that causes secretion of said  
biofilament by said cell;

(b) culturing said transfected cell; and

(c) isolating said biofilament from the culture medium of said cultured transfected  
cell.

10 15. The method of claim 13 or 14, wherein said biofilament is spider silk.

16. The method of claim 15, wherein said spider silk is dragline silk.

17. The method of claim 13 or 14, wherein said biofilament, when secreted such  
that the secretion is subjected to shear forces and mechanical extension, has a poly-  
alanine segment that undergoes a helix to a  $\beta$ -sheet transition, said transition forming a  $\beta$ -  
crystal that stabilizes the structure of said biofilament.

15 18. The method of claim 13 or 14, wherein said biofilament has an amorphous  
domain that forms a  $\beta$ -pleated sheet such that inter- $\beta$  sheet spacings are between 3  
angstroms and 8 angstroms in size.

19. The method of claim 13 or 14, wherein said biofilament has a C-terminal

amino acid motif comprising an amorphous domain and a crystal forming domain, said motif having a sequence that is at least 50% identical to SEQ ID NO: 2.

20. The method of claim 13 or 14, wherein said biofilament has a consensus sequence that is at least 50% identical to SEQ ID NO: 3.

5 21. The method of claim 13 or 14, wherein said animal is a mammal.

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